Space Weather Technical Forecast

Issued on Wednesday, 14 August 2024 at 13:25 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: M-class flares expected, a chance of X-class flares. A chance of S1/Minor radiation storming.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been High with three M-class flares and a single X-class flare observed in the past 24 hours, the latter of which peaked at X1.1 at 14/0641 UTC originating from AR3784 in centre disk. There are nine sunspot regions visible on the disc. AR3784 in centre-north is now the largest and most active region, with the leading and trailing portions connected to the large compact central spot, therefore containing numerous delta spots in a somewhat unusual configuration, with significant magnetic complexity. AR3780 situated in the southwest is large but has begun to decrease in areal extent, it retains a complex magnetic structure with at least one delta spot around the large and compact central spot. The previously active Ex-AR3777 is out of sight around the southwest limb. All other spots are currently small and simple.

A halo CME is beginning to be observed, originating near centre disk associated with the X1.1 flare from AR3784 around 14/0641 UTC. Analysis of this feature will be undertaken when more imagery is available, but given it's location, an Earth directed component is likely.

Solar Wind / Geomagnetic Activity: Solar wind parameters measured at L1 by DSCOVR/ACE were indicative of waning CME magnetic cloud conditions, with perhaps up to two embedded weak transients. Solar wind speeds were slow-ambient to slightly elevated, around 380-450 km/s. Density was around average but above between 14/0200-0500UTC, with a peak of 16 ppcc observed at 14/0238 UTC. The Interplanetary Magnetic Field, Bt, was initially moderate, starting around 13nT before easing back to weak after 13/2100 UTC. The north-south component, Bz, started positive, became moderately negative between 13/1745-14/0200 UTC before becoming mostly weakly positive thereafter, with fluctuations between +8/-7nT. Phi angle was initially mostly positive (away from the Sun) before rotating to mostly negative (toward the Sun) after 14/0800 UTC. Geomagnetic activity ranged between Quiet to Active levels (Kp 1-4).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 remained at background below the S1 Minor Radiation Storm threshold. High energy electron flux (greater than 2MeV) observed at GOES16 were predominantly at background levels. The 24-hour fluence was steady and well below the Active threshold, with 1.05e6 integrated pfu observed at 14/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate to High solar activity is forecast, with M-class flares expected and a chance of an isolated X-class flare.

Solar Wind /Geomagnetic Activity: No Earth directed CMEs currently feature in the forecast period, though a possible CME associated with the X1.1 flare at 14/0641 UTC is slowly appearing on imagery. Analysis of this feature will be undertaken when more imagery is available. Otherwise, there are no significant solar wind enhancements expected in the period, with solar winds remaining slow-ambient or perhaps slightly elevated at times.

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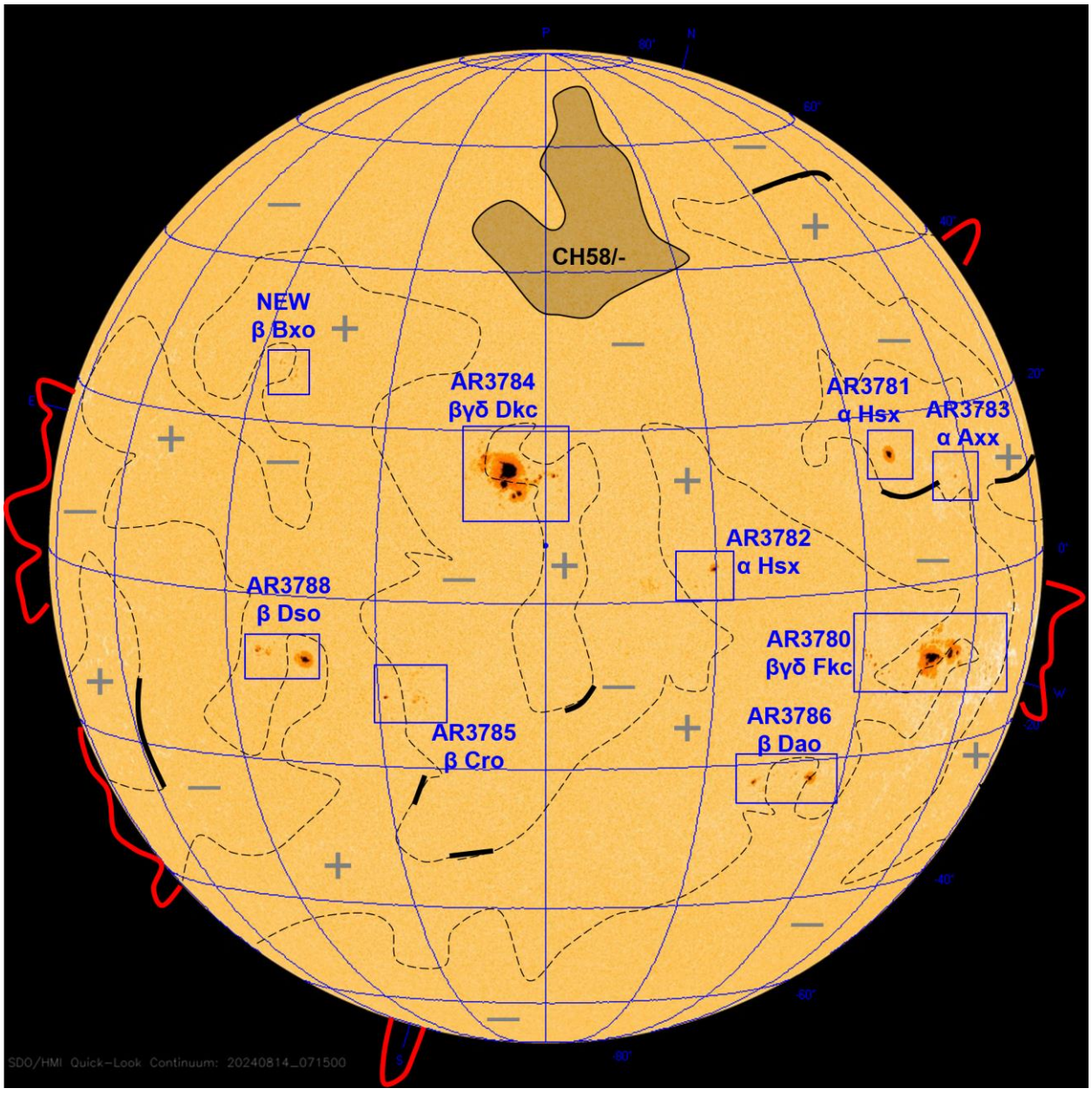
Geomagnetic activity should remain Quiet to Unsettled (Kp 0-3) with a chance of Active (Kp 4) intervals, barring any CME arrivals.

Energetic Particles / Solar Radiation: A heightened risk of flare activity brings a chance of reaching/exceeding the S1 Minor Radiation storm level should any significant flares occur from active regions in the western hemisphere, though this risk reducing slightly from day 2. The high energy electron flux is forecast to be at mostly background levels. The associated 24-hour fluence is expected to remain below the Active threshold (1e8 integrated pfu).

Figure 1. Solar Analysis Valid



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

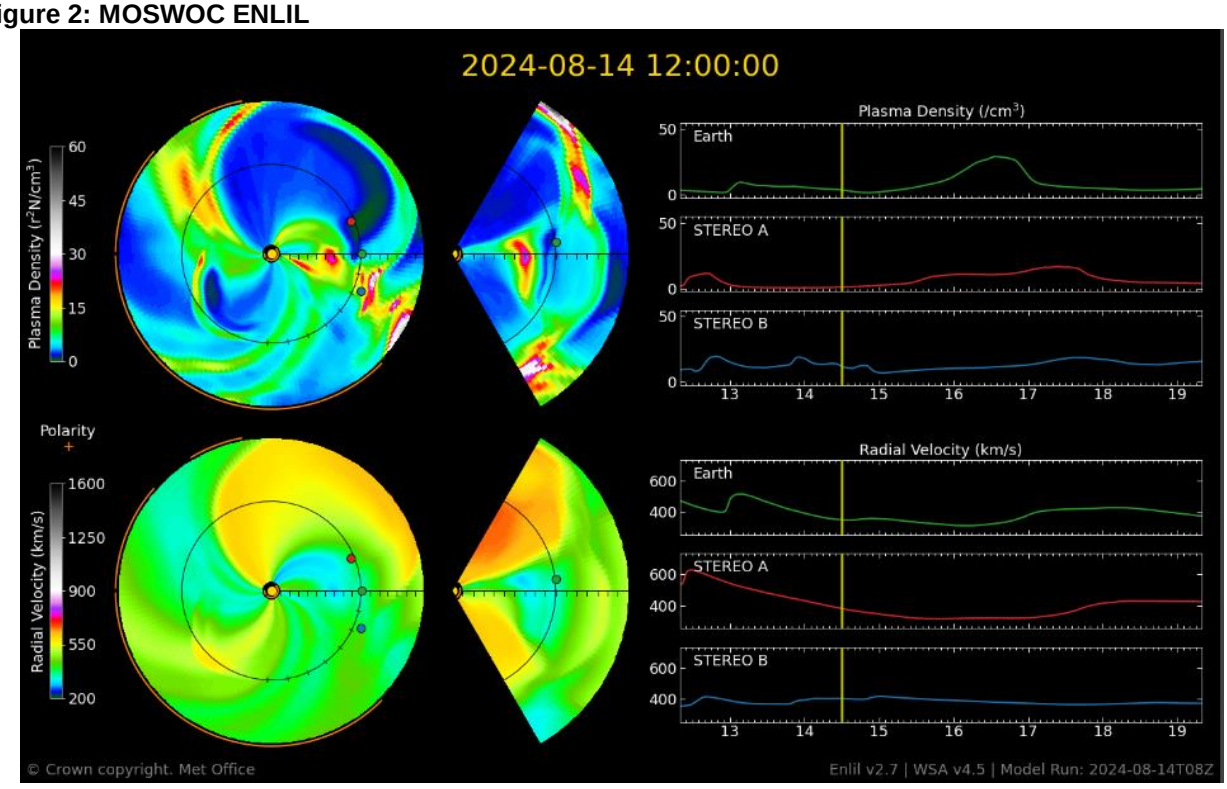
No Earth directed CMEs currently feature in the forecast period, though a halo CME is beginning to be observed, originating near centre disk associated with the X1.1 flare from AR3784 around 14/0641 UTC. Analysis of this feature will be undertaken when more imagery is available.

Otherwise, there are no significant solar wind enhancements expected in the period, with the fast wind from negative coronal hole 58 expected to pass north Earth-Sun line with no appreciable enhancement expected. Barring any possible CME enhancements later in the period, solar winds should remain slow-ambient or perhaps slightly elevated at times.

Geomagnetic activity should remain Quiet to Unsettled (Kp 0-3) with a chance of Active (Kp 4) intervals, barring any CME arrivals.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	15	10	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: MOSWOC ENLIL



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Radio Blackouts - X-Ray Flares:

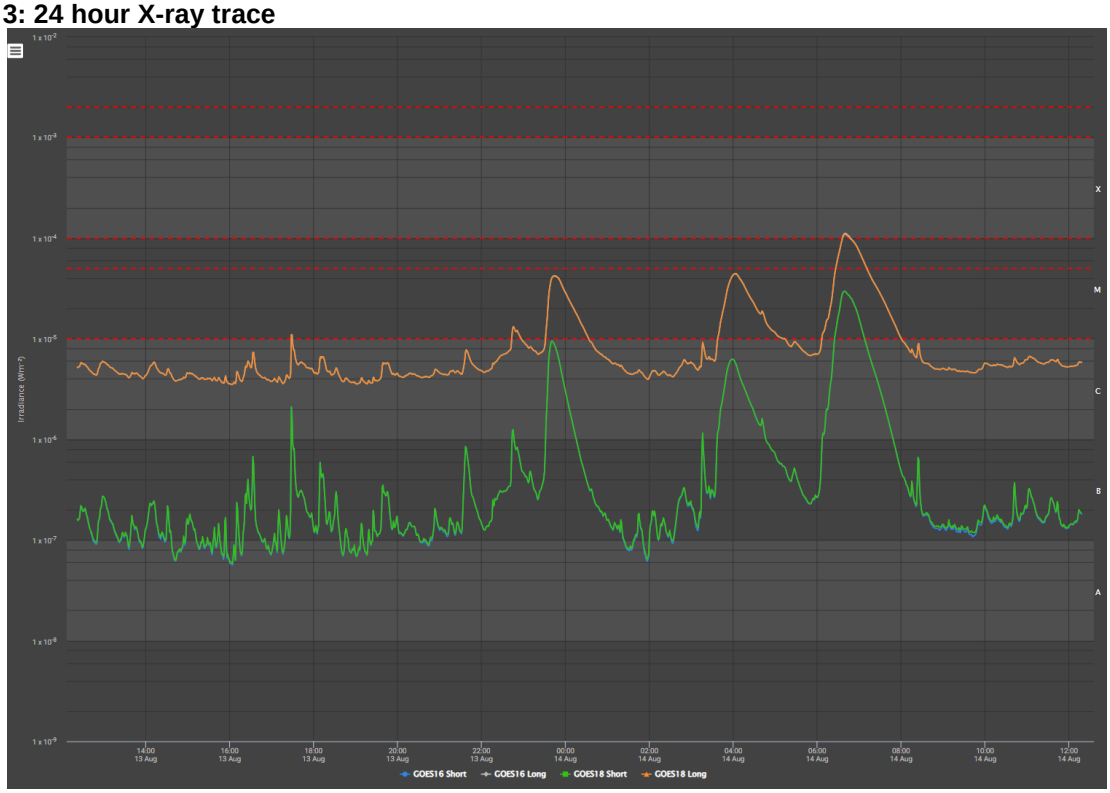
Solar activity has been High with three M-class flares and a single X-class flare observed in the past 24 hours, the latter of which peaked at X1.1 originating from AR3784 in centre disk.

There are nine sunspot regions visible on the disc. AR3784 in centre-north is now the largest and most active region, with the leading and trailing portions connected to the large compact central spot, therefore containing numerous delta spots in a somewhat unusual configuration, with significant magnetic complexity. AR3780 situated in the southwest is large but has begun to decrease in areal extent, it retains a complex magnetic structure with at least one delta spot around the large and compact central spot. The previously active AR3777 is almost out of sight as it rotates around the southwest limb. All other spots are currently small and simple.

Solar activity is expected to remain Moderate to Strong with Further M-class flares expected and a chance of further isolated X-class flares on day 1 (14 Aug), this reducing to a slight chance by day 2 (15 Aug) as AR3777 rotates completely around the southwest limb.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	80	80	80	80
Very Active	R3 to R5 X Class	No	30	25	25	25

Figure 3: 24 hour X-ray trace



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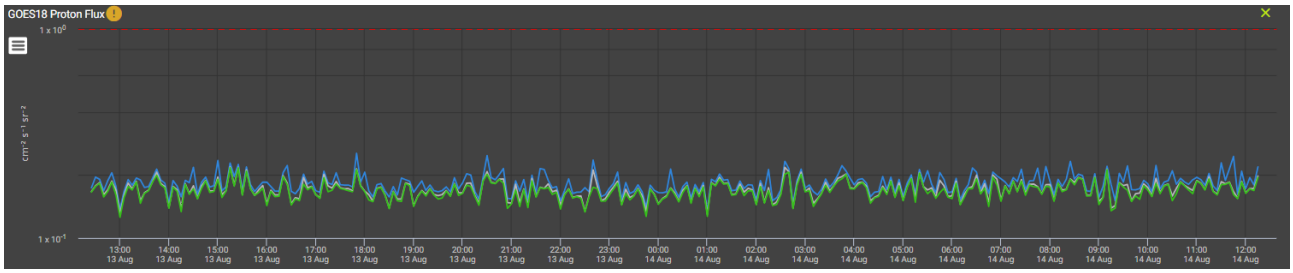
Solar Radiation Storms - (High Energy Protons):

High energy proton flux, as observed by GOES-18, was at background throughout the period. Any further notable flares originating near the western limb will bring a chance of exceeding the S1 Minor Radiation storm level. The risk mainly from AR3780 and AR3777 currently in the western hemisphere, though this reducing by day 2 (15 Aug) as AR3777 rotates further beyond the western limb.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	30	20	20	20
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: 24 hour Proton trace



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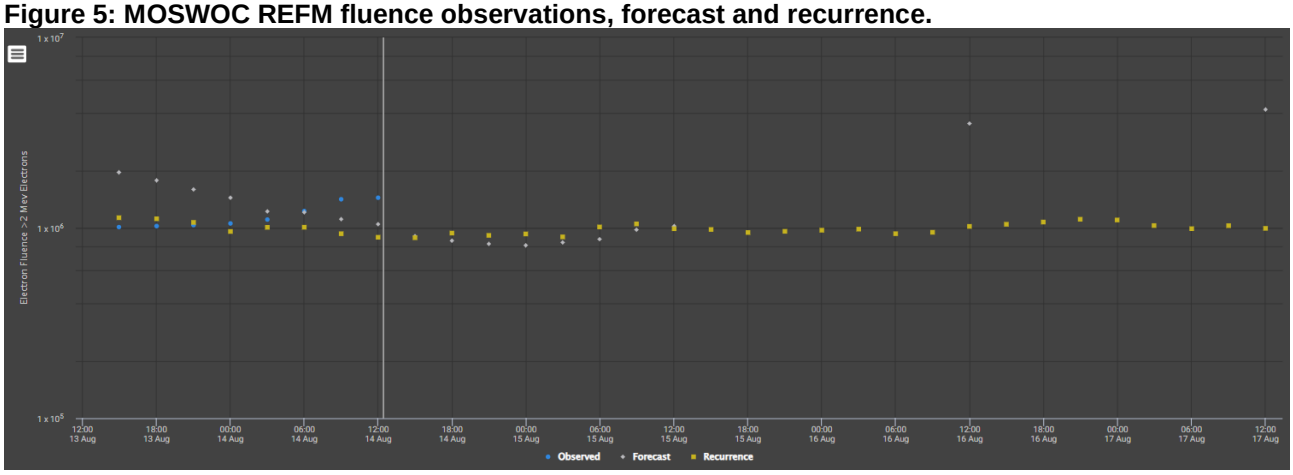
High Energy Electrons Event (≥ 2MeV):

High energy electron flux, as observed by GOES-16, is currently at background. The recent Strong and Severe geomagnetic storming on 12 Aug may see electron flux at GEO increase in time to moderate or even high levels given the potential for electron transfer from currently more highly changed regions below GEO, though this remains a low probability with little appreciable increase in electron counts having recently been observed.

The associated 24hr electron fluence is therefore currently expected to remain below Active (1e8 integrated pfu) levels throughout but with reducing confidence into the period.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	5	10	10
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: MOSWOC REFM fluence observations, forecast and recurrence.



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